**ACTIVITY: Ethical dilemmas in fighting infection**

**Activity idea**

In this activity, students explore ethical issues related to fighting infection. Students learn about the science involved and the associated ethical dilemmas. They have opportunities to discuss and deliberate before making their own decision that they can justify.

By the end of this activity, students should be able to:

* explain some of the science involved in the issue
* explain some of the ethical aspects of the issue
* be able to make a decision about the ethical issue
* be able to justify their decision.

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**Introduction/background**

Tension can result from scientists’ discoveries and how that knowledge is used. For example, scientists were able to devise a sterile bubble for David Vetter whose immune system did not work. This bubble kept him alive whilst he waited for a suitable bone marrow donor. However, many people did not agree with this because of the impacts on David’s way of life.

Early vaccine pioneer Edward Jenner used a healthy young boy (his gardener’s son) to experiment on – infecting him with cowpox matter to see if this would protect him against smallpox. Fortunately, when infected with the smallpox, the boy survived and the cowpox vaccine appeared to have been effective. It would not be ethical to experiment in this way today. However, Jenner made an important contribution to our understanding of vaccination. He is even known as the Father of Immunology because his work helped other scientists understand how vaccinations work.

Our World in Data reports:

The World Health Organisation (WHO) suggests that vaccination prevents 2-3 million deaths each year. However, while we are certain that vaccines have saved millions of lives, calculating a precise number is impossible. Also the quoted number from the WHO is in important ways a very low estimate.

Using smallpox as an example, Our World in Data says:

It is impossible to know exactly how many people would die of smallpox today if scientists had not developed the vaccine. Reasonable estimates are in the range of around 5 million lives per year, which implies that between 1980 and 2018 around 150 to 200 million lives have been saved.

Although we know that vaccinations save lives, they remain a topical issue. Vaccine technology has improved hugely since Edward Jenner’s early vaccine in 1796. Today’s vaccines are made differently and are much safer however, some people are still wary of them and refuse to be vaccinated. Although vaccinations save millions of lives annually, some people have had negative or adverse reactions and even died from vaccines.

In this activity, there are three questions to explore ethical issues. You could choose one question to discuss with the class, or different groups could explore different ethical questions and report back:

* Should scientists have helped David Vetter to survive?
* Should Edward Jenner have experimented on the young boy?
* Should people be vaccinated against infectious diseases?

**What you need**

* Access to a variety of articles and video clips related to the topic students are investigating (see below)
* 2 A4 size signs: ‘strongly agree’ ‘strongly disagree’
* Optional: chalk or string/ribbon
* [PMI worksheets](#PMI) for the noisy round robin activity
* Teacher resource on [managing classroom discussions](https://www.sciencelearn.org.nz/resources/198-managing-classroom-discussions)

**What to do**

1. Introduce the issues to the class/groups:
* Should scientists have helped David Vetter to survive?
* Should Edward Jenner have experimented on the young boy?
* Should people be vaccinated against infectious diseases?
1. Students investigating each issue read the appropriate articles (or if you’re doing one issue with the class, the teacher could read it to them):
* David Vetter – [The boy in the bubble](https://www.sciencelearn.org.nz/resources/183-the-boy-in-the-bubble)
* Edward Jenner – [The history of vaccination](https://www.sciencelearn.org.nz/resources/181-the-history-of-vaccination)
* Vaccination – [Vaccines and therapies](https://www.sciencelearn.org.nz/resources/180-vaccines-and-therapies), [Infection](https://www.sciencelearn.org.nz/resources/179-infection), [Coronavirus](https://www.sciencelearn.org.nz/resources/2900-coronavirus) and [Immunisation in New Zealand](https://www.sciencelearn.org.nz/resources/182-immunisation-in-new-zealand)

***Warm-up activity***

1. Look at each question. Set up a continuum line – you can use chalk or ribbon/ string to make the line clear if necessary – and place one A4 card at each end. When students have thought carefully about the question, they should move to a position on the line that represents their view. For example, if they agree strongly, move to that end of the line and stand as close to the card as possible. If they disagree with the statement, they might position themselves a couple of metres away from the ‘strongly disagree’ card. If students are unsure or don’t know, they should stand in the middle. Make it clear to the students that there is no right or wrong answer and they should make up their own minds. If appropriate, demonstrate by moving along the line and discussing different positions with the students.
2. Ask students to share their reasons for their place on the line:
* How did you make your decision?
* Did you draw on personal experience?
* Do you feel you needed more information to make a decision?

***Investigating the issue***

1. Students can do some research of their own looking at articles on the internet about the issue they are exploring.
2. Students need to understand the science and the issues in the questions they are investigating. The following questions could form the basis of a group discussion.

*David Vetter – science:*

* Why did David need to be in a bubble? (His immune system didn’t work. Students should have a reasonable understanding of the immune system and what it does – see [The body’s second line of defence](https://www.sciencelearn.org.nz/resources/178-the-body-s-second-line-of-defence) and the interactives [The immune system](https://www.sciencelearn.org.nz/image_maps/68-the-immune-system) and [The immune system in action.)](https://www.sciencelearn.org.nz/image_maps/69-the-immune-system-in-action)
* What were doctors hoping? (That he could have a bone marrow transplant.)
* What would the bone marrow transplant do? (The new marrow may produce immune cells that would protect David from diseases.)
* What was the problem with the bone marrow transplant that he eventually received? (The bone marrow had to be the right match for David’s system so that it wouldn’t be rejected. After 12 years of waiting, the scientists could not find a good match so they decided to risk giving him some of his sister’s bone marrow. It failed because a virus from his sister got into David’s body. This resulted in cancer developing, which David’s body could not fight.)

*David Vetter – understanding the issues:*

* Students should explore David’s life – research the internet and/or watch the documentary released about him in 2005 *The boy in the bubble*. Details about this are online [www.pbs.org/wgbh/americanexperience/films/boy-bubble](https://www.pbs.org/wgbh/americanexperience/films/boy-bubble/). You can watch some excerpts from the documentary online and there are some useful teachers’ notes on ethics on this site.
* Why were people upset that scientists and doctors were keen to have the bubble made for David? (Because many felt the professionals were keen to further their own understanding and study of immunology while David suffered a sad, lonely and seemingly pointless life in the bubble.)
* How do you know he was lonely and sad? What was his relationship like with his family? Did he see them very often? What was his life like? How was it different to yours?
* Should scientists have attempted a bone graft when they knew his sister’s bone marrow did not match his? Could they have anticipated the outcome?
* What has changed now? What would happen to David if he had been born in 2010? (Advances in immunology means now he’d most likely be treated and cured as a baby.)

*Edward Jenner – science:*

* What are vaccines? (See the article [Vaccines and therapies](https://www.sciencelearn.org.nz/resources/180-vaccines-and-therapies).)
* How do vaccines work? (By presenting an antigen – the part of the pathogen that is recognised by the immune system – to the immune system and causing it to create ‘memory cells’ that will respond to the antigen more rapidly in case of future infections. Vaccines can be based on a weakened form of the pathogen, a dead or inactive pathogen, an antigen (protein or molecule from the pathogen) rather than the whole pathogen, or a synthetic molecule made to resemble antigen molecules from the pathogen.)
* What is smallpox? (Probably originated over 3,000 years ago in India or Egypt and is one of the most devastating diseases known to humanity.)

*Edward Jenner – understanding the issues:*

* Are vaccines important? (Millions of lives have been saved through vaccination.)
* What were the dangers of vaccines? (In the early days of vaccine development, the possible side-effects were not well understood. Smallpox was a deadly disease that killed people. Deliberately infecting someone with it was tantamount to killing them. Of course, Edward Jenner believed in his hypothesis and didn’t think the boy would die.) See a [cartoon version of the Jenner story](https://www.youtube.com/watch?v=jJwGNPRmyTI) on YouTube.
* What would have happened if a vaccine for smallpox had not been developed?
* How do scientists test their vaccines today? What differs between historic vaccines and modern vaccines? (Developing vaccines is a long and vigorous process – see the article [Vaccines and therapies](https://www.sciencelearn.org.nz/resources/180-vaccines-and-therapies).)
* Why is Jenner important to immunology? (He ‘proved’ that vaccines work and developed scientific understanding about vaccinations that later scientists could build on.)
* The last known case of a naturally occurring smallpox case in the world was in 1977. Why is this not around anymore?

*Vaccination – science:*

* What are vaccines? See the article [Vaccines and therapies](https://www.sciencelearn.org.nz/resources/180-vaccines-and-therapies).)
* How do vaccines work? (By presenting an antigen – the part of the pathogen that is recognised by the immune system – to the immune system and causing it to create ‘memory cells’ that will respond to the antigen more rapidly in case of future infections. Vaccines can be based on a weakened form of the pathogen, a dead or inactive pathogen, an antigen (protein or molecule from the pathogen) rather than the whole pathogen, or a synthetic molecule made to resemble antigen molecules from the pathogen.)

*Vaccination – understanding the issues:*

* Why are vaccines important? (Millions of lives have been saved through vaccination.)
* What are the potential dangers of vaccines? (Vaccines may involve a weakened strain of the disease although this is becoming less common as more synthetic vaccines are being used. The use of such vaccines has sometimes been linked with disease in some patients. In some cases, this appears to be because a batch of vaccines was not handled properly, while in others, the patient reacted poorly or the virus mutated inside the body to become virulent. There are sometimes side-effects with different vaccines for different people. Some people may be allergic to some of the components of the vaccine causing a negative reaction as well.)
* There is a vaccine schedule for people in New Zealand. What is recommended today and why? Are there any issues around these vaccines? (For example, MMR has been erroneously linked with autism – see [Immunisation in New Zealand](https://www.sciencelearn.org.nz/resources/182-immunisation-in-new-zealand).)
* The last smallpox case in the world was in 1977. Why is this not around anymore?

***Using an ethical approach***

1. Small groups of students could use the [Ethics thinking toolkit](https://www.sciencelearn.org.nz/resources/2363-ethics-thinking-toolkit) to help them explore their chosen issue.

There are a number of ethical approaches used for discussing ethical issues. Below are three common ones that could be used to discuss the issues around fighting infection – consequentialism, rights and responsibilities, and autonomy. The questions are examples of what might be asked within each approach. To explore these issues, you may wish to use one, two or all three approaches, depending on the ability of the students and the time you have to explore the issue.

*Consequentialism*

Consequentialism is to do with the consequences of actions. Using this ethical approach, we weigh the benefits and harms resulting from our actions:

* Who/what is affected by this issue?
* What are the benefits for those involved?
* What are the harms for those involved?
* Are some consequences greater or lesser than others?
* If one is harmed and another benefits, how do you decide who or what matters most?

*Rights and responsibilities*

Rights and responsibilities are closely related – the rights of one imply the responsibilities (or duties) of another to ensure those rights.

* Who/what is affected by this issue?
* What groups have rights associated with this issue? What are their rights?
* What groups have responsibility to ensure that the rights are achieved?
* Do we value some rights more than others? Whose rights do we want to protect?
* Do any codes, declarations and/or conventions relate to this issue?

*Autonomy*

Autonomy recognises the right to choose for yourself.

* Who/what is affected by this issue?
* What effects might my choice have on others?
* Is there a public cost associated with my choice?
* What effects might others’ choices have on me?
* Does everyone have to do the same thing? Will this cause problems?
* Is informed consent important?

***A consequentialist approach using a noisy round activity***

1. Alternatively, a noisy round robin activity could be used to identify consequences for stakeholders.
* Identify the stakeholders in the issue, for example, for the vaccination issue, stakeholders might include children, parents, doctors, scientists (immunologists), someone who is suffering from an infectious disease, someone who has had a side-effect from a vaccine, anti-vaccination lobbyists, pregnant woman, elderly person, pharmaceutical company, government etc). Make a class list.
* Divide the class into 6 groups. Spread them out around the room and give each group one of the [PMI worksheets](#PMI). (The six stakeholders on the PMI worksheets are examples of two stakeholders that can be used for each of the three discussions and should be changed to align with stakeholders your class identified during discussions.)
* When you say ‘pathogen’ (or some other word that gives the signal), the students have 2–3 minutes to identify harms and benefits for the stakeholder on the PMI worksheet. A writer for the group records the idea(s) on the sheet. When you call ‘pathogen’ again, the groups move to the next piece of paper (the paper stays at each station) and so on until they have added to all of the sheets. Ideas cannot be repeated so students cannot copy what is already there.
* When the groups are back at their original stations, a representative from each should feed back to the class. Compile a list of harms and benefits on the board and discuss whether some are more or less important than others.

***Debate***

1. Divide the class into groups of three and have them prepare for a debate – half the groups should argue in favour of the issue/s (for example, people should be vaccinated against infectious diseases) and half against. You may choose to assign the response to each group (even if students don’t personally agree with a particular view, it will give them good practice at considering other perspectives). Have debates between sets of opposing groups. The class could comment on which group had the most compelling argument and why.

***Role-play***

1. Groups of students are assigned stakeholder roles from their ethics exploration:
* In the David Vetter case, stakeholders might be David, his parents, his sister, a friend, scientists involved, NASA engineers, doctors, nurses, human rights commission, etc.
* In the Edward Jenner case, stakeholders might be Edward Jenner, the boy, the boy’s father, doctors of the time, other medical scientists, a person infected with smallpox, a non-infected person living among smallpox-infected people, an immunologist from the 21st century, etc.
* In the vaccination case, stakeholders might be children, parents, vaccine scientists (immunologists), doctors, a person suffering with an infectious disease, someone who has had a side-effect from a vaccine, anti-vaccination groups, pregnant woman, elderly person, pharmaceutical company, government, etc.
1. The stakeholders in each group then convene for a discussion on the issue. Each stakeholder should state and justify their viewpoint. They may then be challenged or questioned by others. Encourage students to stay in role and not to give their personal view. The role-play could be done instead of or as well as the debate.

***Final continuum***

1. Repeat the values continuum for each of the issues. Discuss the following;
* Have you changed your place in line?
* Why? Why not?
* How did you make your decision?
* Did you draw on personal experience? New information?
* Do you feel you need more information to make a decision?

**Transactional writing**

1. As a formative or summative assessment activity, students could express their argument through transactional writing. Discuss how to plan the essay:
* Introduction (state the issue – check students are clear about the issue).
* Explain the issue.
* Explain what side you are on.
* Give reasons (scientific evidence to support your argument).
* Use powerful words (for example, therefore, in addition to, furthermore, equally important, there is evidence, in conclusion).
* Sum up ideas (conclusion).
* Decide on number of paragraphs and what each of them will be about (for example, paragraph 1 – introduce the issue and give background, paragraphs 2 and 3 – present your own view and give reasons to support your view (possibly add another paragraph to show what other people think and why), paragraph 4 (or 5) – sum up the ideas.
1. Give students time to plan their writing and to make notes on what they plan to write for each paragraph (they could mind map it). These could be shared with the class to help others who might be struggling. Give students an adequate amount of time for the writing.

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| I am Edward Jenner. I lived from 1749–1823. I vaccinated a young boy against smallpox. It was considered the first ‘official’ vaccination. I gave him cowpox first and then smallpox. Doing this means I may have experienced the following… |
| **Benefits (PLUS)** | **Harms (MINUS)** |
| **An INTERESTING thought or idea (possible outcome of having taken this action)** |

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| --- |
| I am Edward Jenner’s gardener’s son – the boy he vaccinated against smallpox. It was the first vaccination. Doing this to me means I may have experienced the following… |
| **Benefits (PLUS)** | **Harms (MINUS)** |
| **An INTERESTING thought or idea (possible outcome of having taken this action)** |

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| --- |
| I am David Vetter – the boy whose immune system did not work. Scientists devised a sterile plastic bubble for me to live in. I lived there for 12 years. Doing this to me means I may have experienced the following… |
| **Benefits (PLUS)** | **Harms (MINUS)** |
| **An INTERESTING thought or idea (possible outcome of having taken this action)** |

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| --- |
| I am John Montgomery – a doctor caring for David Vetter. I told his mother that we could keep him in a plastic bubble until she had another child who could produce bone marrow that would be a match for David. A transplant would cure him. Unfortunately, his sister was not a match. Doing this means I may have experienced the following… |
| **Benefits (PLUS)** | **Harms (MINUS)** |
| **An INTERESTING thought or idea (possible outcome of having taken this action)** |

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| --- |
| I am an immunologist. I am developing a TB vaccine because TB is increasing across the globe and the old TB vaccine doesn’t seem to be very effective anymore. As part of my job, I might experience the following… |
| **Benefits (PLUS)** | **Harms (MINUS)** |
| **An INTERESTING thought or idea (possible outcome of having taken this action)** |

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| --- |
| I am 11 years old. I’ve been told I need to be vaccinated against Meningococcal B. My friend had the vaccine yesterday and now has a swollen and aching arm. He doesn’t feel too well and isn’t at school today. I hate injections. Having this vaccine means I might experience the following… |
| **Benefits (PLUS)** | **Harms (MINUS)** |
| **An INTERESTING thought or idea (possible outcome of having taken this action)** |